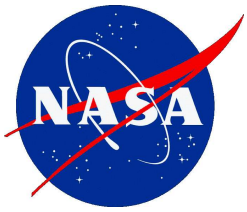


National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, MD

OMI Science Data Quality Assessment Viewer Software User's Manual

OMI-QA_Viewer_Users_Manual

Under NASA SESDA Contract# NAS5-00220

Work Activity 922-001-01
Original: August 12, 2004
Revised: November 2nd, 2004
Version 1.2.0

Document Profile Information (Inside Cover)

OMI-QA_Viewer_Users_Manual	
Title:	OMI Science Data Product Quality Assessment Viewer Software User's Manual
Version:	1.2.0
Type:	Software User's Manual Document
Audience:	This document is written for OMI Science Team. This document is the User's Manual for the OMI QA Viewer visualization software.
Source/Format:	Microsoft Word
Author(s):	Konstantinos Stefanidis
Status:	Draft
Distribution:	Public [ ] OSST Only [ ] Confidential [ ]
Approval:	Person Approve CM OK [ ] Post OK [ ]
Post Location:	https://omiwww.gsfc.nasa.gov/Documents/OMI-QA_Viewer_Users_Manual.pdf
Abstract:	This document is written for OMI Science Team. This document is the User's Manual for the OMI QA Viewer visualization software.
See Also:	OMI-L1B-Format, OMI-QA_FLAGS_L1B, OMI-QA_L1B_FlagsExplained in https://omiwww.gsfc.nasa.gov/cm/doclist.md?CAT=QA

Table of Contents

Table of Figures

1. Summary

The OMI QA Viewer software package is an interactive visualization tool developed using object oriented and widget programming with Interactive Data Language (IDL) (created by Research Systems Incorporated-RSI) to visualize the OMI level 1b and level 2 data products. This software package was created keeping in mind the needs of its intended users i.e. the Quality Assessment Team members and the Science Team members. Our intention in creating this tool was add options that will facilitate the work of the researches but not to create a full fledged analysis tool. In designing the software we added options that extract the data or images from the data sets for further analysis or for the purpose of making a presentation. With respect to user interaction with the software we kept as close as possible to the "*look and feel*" of common window applications.

This document describes the installation procedure and explains the functionalities of this software package. As the needs of the Science Team members and the Quality Assessment Team members and we add features, we will update this document to describe those enhancements.

1. Introduction

This section provides information on the requirements for downloading, installing, and running the OMI Quality Assessment Viewer Software.

1.1. Hardware Requirements

In order for the software to run the computer has to have sufficient resources to perform the various tasks. The available amount of Random Access Memory (RAM) is a very important factor. It has to be proportional to the data volume the user will be viewing and definitely not less than 512Mbytes. The software will access data sets stored in a medium attached to the computer such as a hard disk. The capacity of the hard disk required for the software itself is minimal by today's standards but the drive has to have sufficient available capacity to store the required data sets as file sizes can exceed 500Mbytes in size. The display shall be capable of producing at least 1048 by 768 color pixels (at least 16bit colors depth) and the computer shall also have a keyboard and a mouse for the user input.

1.2. Software Requirements

To run the OMI QA Viewer the user has the following options:

1.2.1. Obtain the IDL code and licenses from RSI (http://www.rsinc.com). The software code for the OMI QA Viewer was developed in IDL 5.6 and later moved on to IDL 6.1. The user is urged to visit the OMI QA web site for information on the IDL version used to create the software.

1.2.2. Obtain the IDL Virtual Machine executable from the site: (http://www.rsinc.com/idlvm/index.asp).

1.3. Acquiring the Software Package

The OMI QA Viewer can be downloaded by visiting the OMI QA web site (https://omiwww.gsfc.nasa.gov) under the header *Tools*. The file downloaded into the client machine is a tarred file that contains the IDL source code (files with extension

.pro), a pre-compiled version of the program (file with extension *.sav*), a plain-ASCII text file (README.TXT), and a script file described in a separate document. Once the download is complete the user can proceed with the installation of the software, following the instructions listed in the nest section (see section: *1.4.Installation*).

1.4.Installation

In order to install the software the user does not need to have special computer administrative privileges. The program provided can be compiled or directly executed by any user in a multi-user environment.

After obtaining the software (see section 1.3) the user must locate the downloaded file, and copy it to a directory of choice where the user has read, write, and execute permission. To un-tar the file the command appropriate for the Linux and Unix operating systems of the computer must be used.:

tar –xf <filename>.tar

where the *<filename>.tar* should be replaced with the name of the downloaded file.

1.5.Running the software

Once the steps in 1.4 have finished executing and the installation completed successfully the user can start and IDL session from within the same directory where the downloaded files were extracted (please see *IDL's User's Guide* on how to start an IDL session or contact your computer administrator). From within the IDL session the user can either run the pre-compiled version or compile the source code provided and execute the program. For more details on how to run the code please refer to section *The OMI QA Viewer Environment* (section 2).

1.6.Support

The QAT supports all formal releases of the OMI QA Viewer. The user is provided with the source code but the QAT cannot provide support for code altered by the user. For any publications or presentations for which unaltered software is used, the QAT would

greatly appreciate acknowledgement of the use of the OMI QA Viewer. Despite our best efforts to provide the STMs with versatile and robust software to view the OMI data sets some bugs may emerge. In this case the user can contact the QAT with a bug report (please see section: *4.3 Reporting a Bug*). The QAT will prioritize and to fix the problems based on available resources and provide the user community with updates.

The user's feedback is welcome and we kindly ask you to provide us with constructive comments on how we can improve the code to make the software better serve your needs. We will incorporate your suggestions on a best effort basis.

1.7. Relevant Documents

For the interested user more information on the OMI science data products can be found at the OMI QA web site (https://omiwww.gsfc.nasa.gov) under the header *Documents*. Information on the file specifications can be found in the document: *RD01 GDPS Input/Output Specification (IODS) Volume 2, SE-OMIE-7200-DS-467, Issue 1, 9 April 2003.* For explanations of the various flags contained in the data files and their recommend use please refer to the documents: *GDPS Input/Output Data Specifications (IODS) Volume 1*, SD-OMIE-7200-DS-466, *RD02 OMI GDPS: Use of flags, RP-OMIE-KNMI-365, Issue 1, 8/1/2002*, and *ATBD-OMI-01, OMI Instrument Description and Level 1B Product*

For the user who wants to gain more familiarity with IDL RSI offers a number of books (http://www.rsinc.com) while information on programming techniques can also be found in the world wide web.

2. The OMI QA Viewer Environment

2.1. Description of the OMI QA Viewer

To begin using the OMI QA Viewer you need first to complete the software installation (see section 1.4) and have OMI level 1B datasets available in a locally accessible mass storage medium. For the purpose of this manual screen snapshots were taken using OMI data sets which the user can download from the OMI Data Analysis Processing System (ODAPS) at http://omisips1.omisips.eosdis.nasa.gov:8200 or from the TLCF at /omi/live/consistent

To start using the OMI QA Viewer software, the user needs to start an IDL session first. This session will preferably start from the same directory where the code is located (for software code located in different directories please read the *IDL User's Manual*). At the IDL prompt type:

omi_qa_viewer

Alternatively the user can also provide a path/filename as shown in the following example:

Omi_qa_viewer, filename='data/data/OMI-Aura_L1_OML1BRVG_2003m0417t0136-o00024_v001-2004m0112t164628.he4'

If the first method was used the generated output on screen will look like Figure 1, in page 6. If the second method was used, the file (if path/filename were correctly provided) the screen will look like figure Figure 2 in page 7 (if file access problems arise please contact your local system administrator). The difference between the two windows is that the second window also includes the <Swath> menubar item for the user to select the swath to attach to. This menubar item will also appear in the first window once the user has selected a file (see 2.3.2 in page 7).

The window shown in Figure 1 and Figure 2 is called the *overview window*. This window allows the user to see a snapshot of the data file and navigate through the swaths and various fields stored in the OMI Level 1B data product files (for a detailed description of OMI Level 1B data product please see *Relevant Documents* section 1.7 in page 4). This window is not re-sizable.

2.2. Overview Window Features

In the overview window the user can find the pull-down menu bar, the three-overview panels with their corresponding sliders, and a table displaying the number of fill values found. In the sections that follow the user will find more details about each item.

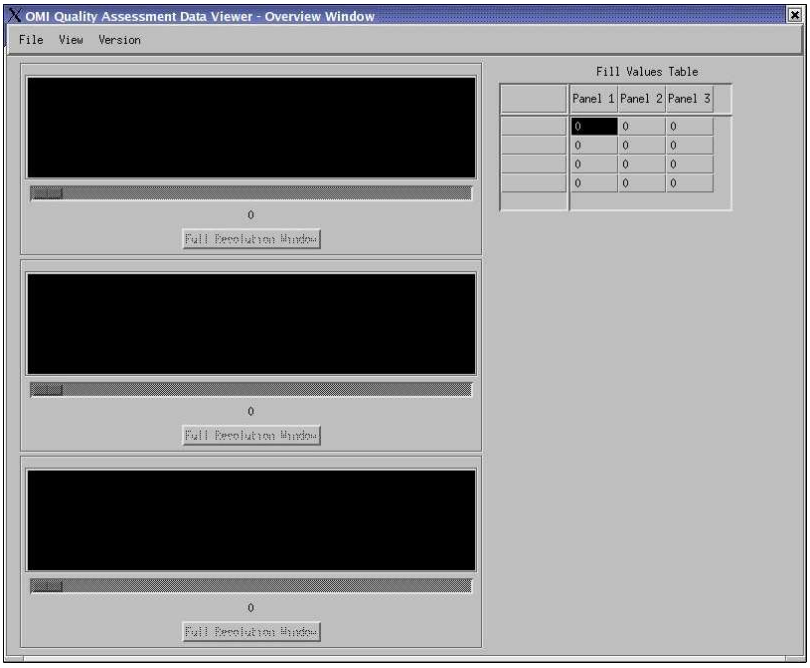


Figure 1: The overview window: no file opened

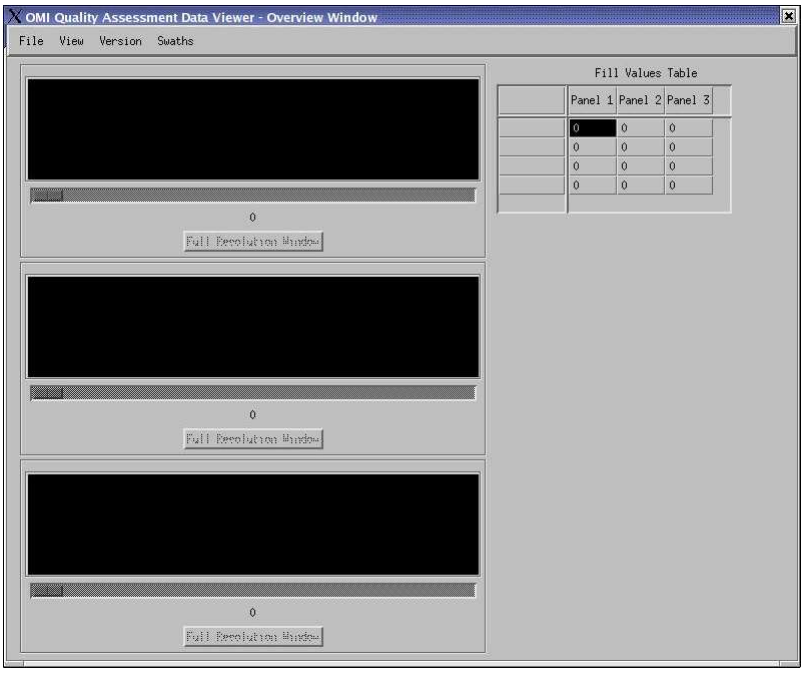


Figure 2: The overview window when path/filename were provided at startup or file was opened; <Swath> menubar item appears

2.3. Working with the Overview Window

2.3.1. The Window Bar

The top of the overview window (the blue-colored bar) displays the name of the software and the window's title: *Overview Panel*.

2.3.2. The Pull Down Menus

This section, describes the pull down menus found in the overview window. Like most window graphics user interface applications the OMI QA Viewer has the menu bar. The menu items are:

1. *File*
2. *View*
3. *Version*
4. *Swath* – appears after a file was opened
5. *Field* – appears after the selection of a swath

2.3.2.1. File menu bar item

The <File> menu item when selected allows the user to perform the following tasks: *Open* or, *Close* a file, and *Exit* the software. To open a file, select the <File>, and then *Open* (see Figure 3). A new window appears that allows the user to select a file, and navigate the directory structure to locate and select a file.

Figure 3: The file selection window

The user can select a file, or use the <Directories> to navigate the directory structure and locate a file to open. Upon successfully opening a file, the <Swath> appears on the menu bar (see Figure 2 on page 7).

When a file successfully is opened the user can view its corresponding metadata file, if available and located in the same directory as the data file. A new menu item also shows up in the menu bar, called <Swath>. This pull-down menu allows the user to select one of the available data swaths to attach to (see Figure 4 and Figure 5)

Figure 4: Swath list available for the *Visible* level 1b data product

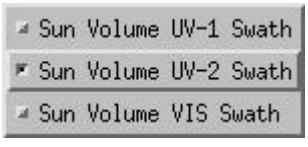


Figure 5: Swath list available for the *Irradiance* level 1b data product

From the available swaths the user can select the swath to attach to. The selected swath will appear with the radio-button to its left depressed indicating that the particular swath

was selected. The user must select a swath even though a data file, as shown in Figure 4, might contain only one swath. Without selecting a swath, as shown by the radio button, the user cannot proceed. After the swath has been selected, a new menu item appears in the menu bar the <Fields> pull down item (see Figure 6). This pull-down menu lists all fields available to visualize within the selected swath (see Figure 7).

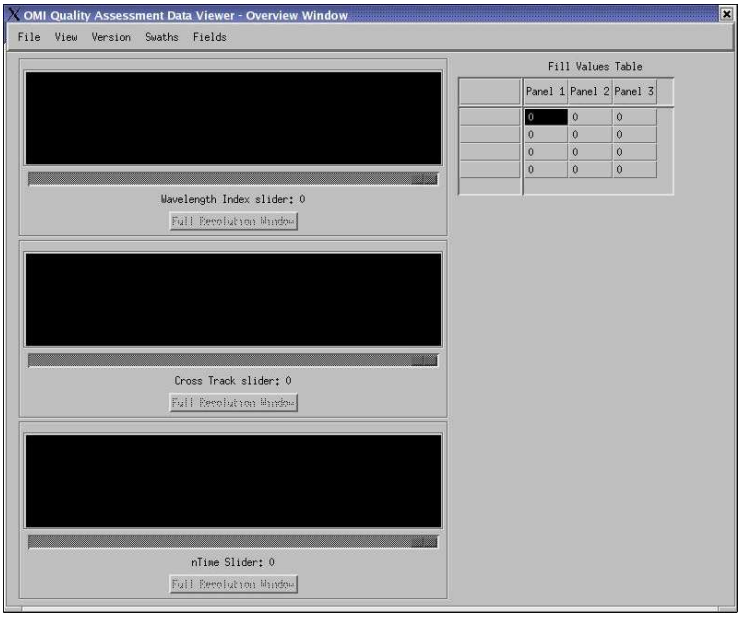


Figure 6: The overview window with the <Fields> menu item added on the menu bar

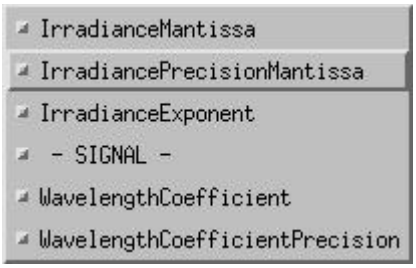


Figure 7: The <Fields> pull-down menu for an *Irradiance* data product file

Once a field is selected the corresponding radio button to the left of the field name will appear depressed and the data from the field will be loaded on the overview panels.

It is important to note that a field identified as <SIGNAL> is not part of the original OMI level 1b data product. Since the data product stores the Mantissa and Exponent of the actual measurement as separate numbers, the Viewer calculates the signal and allows the user to display the result, view and plot its values. For the interested user the Mantissa and Exponent are still provided for viewing and plotting.

2.3.2.2. The View menu bar item

When the <View> menu bar is selected the user can view the contents of the metadata file if this is located in the same directory where the data product file is located.

2.3.2.3. The Version menu bar item

The <Version> menu bar item provides information on the version of the OMI QA Viewer software. For any communications with the QAT the user should provide the version of the software used. The version information can also help the user to determine if there is a more recent release of the software on the OMI QA web site..

2.3.3. The Image Windows

Once a field is selected the overview panels display an image. The sliders underneath the image panel also become activated and the user can use them to navigate the data, in the selected field.

All three overview panels will display an image as long as the dimensions of the data fields are greater than one. In cases such as in the Irradiance data products, if only 1 measurement is taken, then only the bottom panel will contain an image.

NOTICE: The image panels in the overview window have different scale factors. The intent of the image panels is to provide quick access to the data sets. The images are displayed to fit the available image panel space. Thus if the image has larger dimensions than the available space it will be reduced in size to fit in the panel and vice-versa.

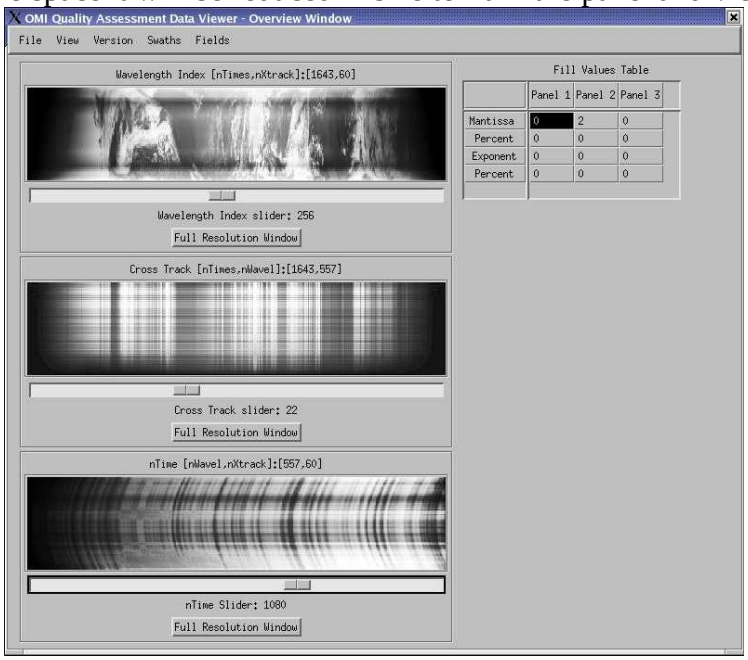


Figure 8: Images displayed on the overview panels after a field was selected

Once an image is displayed on the panel the corresponding slider underneath the image becomes sensitive to the users input. If more images are available in the data product file the user can navigate and view them by moving the slider. If only one image is available then navigation is limited to this one image.

2.3.4. The Fill Values Table

The <Fill Values Table> lists the number of fill values found in the data set. For consistency checks the numbers are listed separately for the exponent and the mantissa (when the field selected is the <SIGNAL>). These numbers reflect the number of fill values found only in the images shown and not to the number of fill values in the whole data set.

3. Working with the Data in Full Resolution

3.1. Introduction

After opening a file, selecting the swath and field, the user can press on any of the activated buttons containing the phrase <Full Resolution Window> (see Figure 10). By selecting this option a full resolution window is opened.

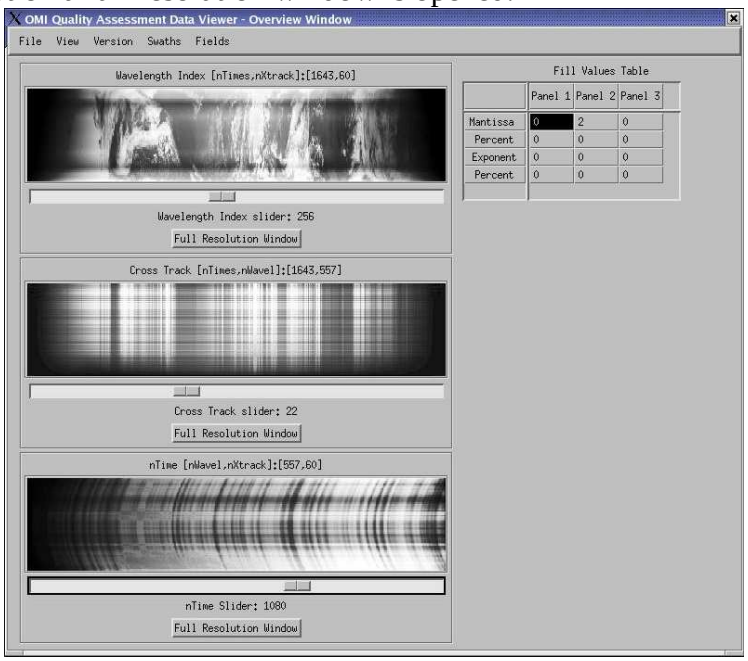


Figure 9: The prompt to open a full resolution window (middle panel)

The full resolution window will automatically resize to display the data set chosen. The full resolution window displays the name of the data product file opened. This title bar also indicates if the image is a selected wavelength, cross-track or nTimes image.

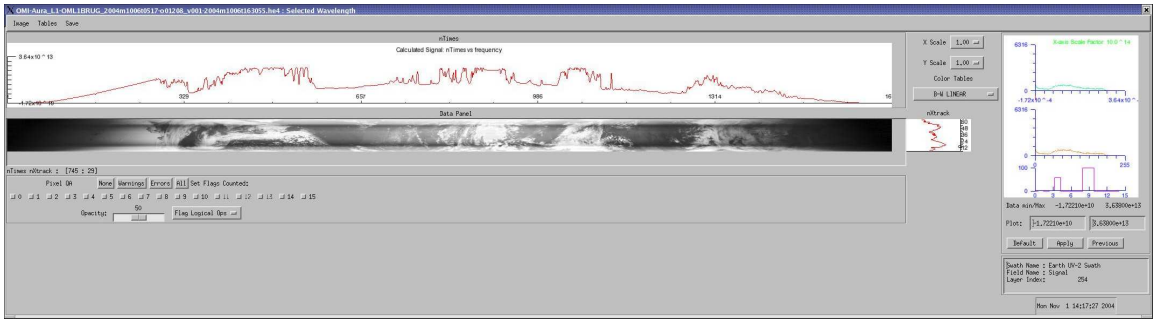


Figure 10: The full resolution window

This window has it's own menu bar. The menu bar items are:

1. *Image*
2. *Table*
3. *Save*

The <Image> pull down menu lists a number of image enhancements that are incorporated into the software package. The <Table> menu item opens tables to display data values (for more please see below) or quality assessment flag values. The <Save> menu item offers a list of options to save the window or image into a file.

There are drop lists in the full resolution window: the <X-Scale>, <Y-Scale>, and <Color Table>. The first two drop lists control the scale factor in the X and Y directions respectively for displaying the image and profiles while the Color Table loads a color table. Those are described in detail in sections 3.2.1.6 and 3.2.1.7 respectively.

As the user moves the mouse over the image area the horizontal and vertical profiles are updated. The profiles represent transects on the data set in the horizontal and vertical directions respectively. The range of values for the Y-axis is adjusted to reflect the range of the data set loaded in the window, or according to the adjustments the user has made (see section 3.2.1.9).

3.2.Description of the Components

The first part of the full resolution window presented in sections 3.2.1 through to 3.2.1.7 can be seen in

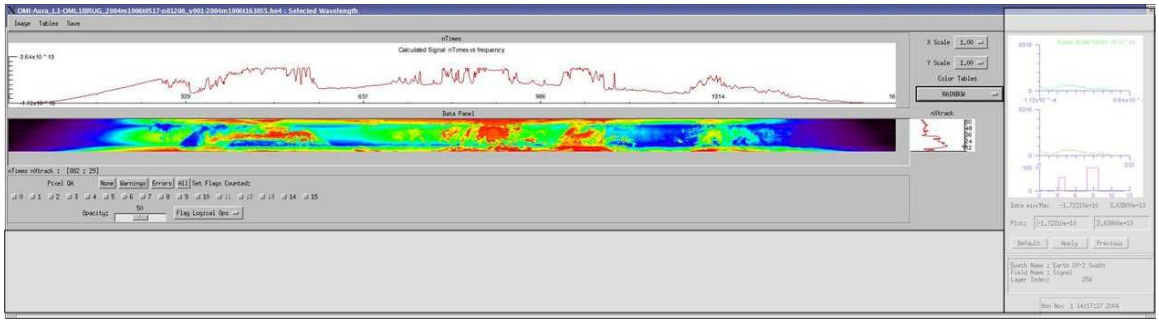


Figure 11: the menu items, image and profile panels, the Pixel QA panel, scaling and color table drop list in the full resolution window

3.2.1. The Window Menu Bar Items

3.2.1.1. The Image Menu

The first menu bar item is called <Image> and list a number of routines used to enhance the appearance of the image on the screen. The options available are:

1. *Histogram Equalization*

2. *None (also re-set)*

By selecting the <Histogram Equalization> option (default) the histogram distribution of the selected data set is equalized to sharpen the image. The <None> option displays the data sets with their original data distribution.

3.2.1.2. The Data Values Table

The user can read the values of the data set loaded on the image panel of the full resolution window, by selecting the <Tables> (see Figure 12), and then the <View Data Values> menu item. A window opens (see Figure 13) and as the mouse moves within the image area the values in the table cells are refreshed to reflect the new mouse position. The data value table will set the column and/or row labels to negative values for columns and rows respectively that do not fall within the area of the image.

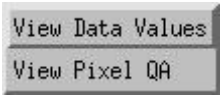
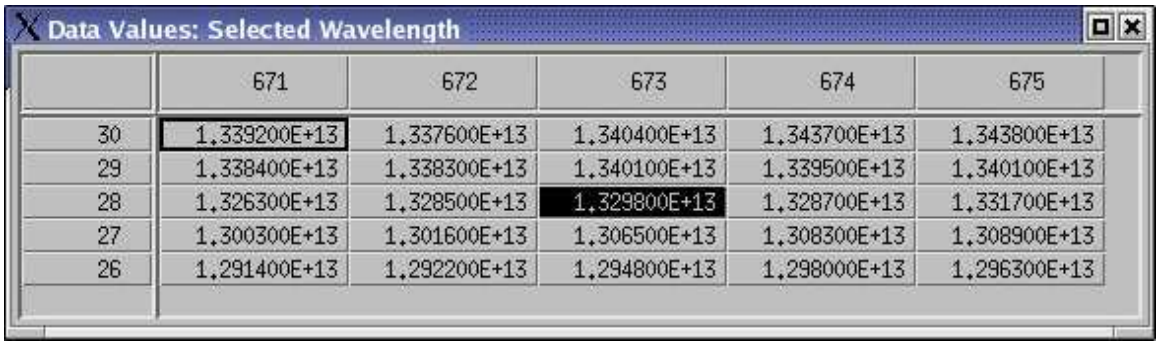


Figure 12: The Tables menu option expanded



	671	672	673	674	675
30	1.339200E+13	1.337600E+13	1.340400E+13	1.343700E+13	1.343800E+13
29	1.338400E+13	1.338300E+13	1.340100E+13	1.339500E+13	1.340100E+13
28	1.326300E+13	1.328500E+13	1.329800E+13	1.328700E+13	1.331700E+13
27	1.300300E+13	1.301600E+13	1.306500E+13	1.308300E+13	1.308900E+13
26	1.291400E+13	1.292200E+13	1.294800E+13	1.298000E+13	1.296300E+13

Figure 13: The data value-viewing table

3.2.1.3. The QA Flags Table

The user can read the values of the quality assessment flags corresponding to the image panel of the full resolution window, by selecting the <Tables> and then the <View QA Values> menu item. A window opens (see Figure 14) and as the mouse is moved within the image area the values in the table cells are refreshed to reflect the new mouse position. The quality assessment values table will set the column and/or row labels to negative values for columns and rows respectively that do not fall within the area of the image.

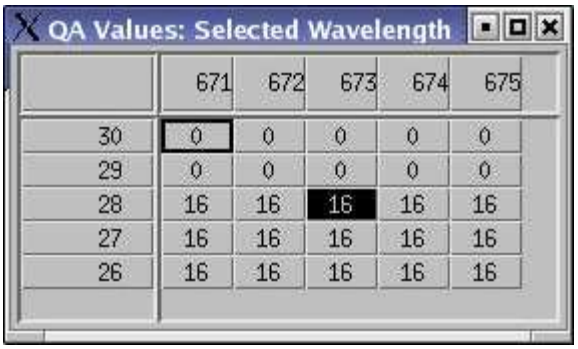


Figure 14: The pixel quality assessment values table

3.2.1.4. The Save option

The user can save the image as it is displayed on screen by opening the <Save> menu and selecting the <Save as JPEG> or <Save as PNG> option. A file selection window opens and the user can provide a name for the file that will be created. This window also allows the user to change the directory where the file will be stored.

The third option in the <Save> menu saves the data window as a file. This file is a binary file that can be read by another IDL program. It contains the image data values and information on the color table used.

Figure 15: The <Save> menu options

Finally, the <Save Window> option is currently implemented for the Linux/Unix environment and calls the *xwd* X-window system window dumping utility. It will store the dumped data as a .bmp file.

3.2.1.5. The Freeze option

The user can freeze the cursor location over certain area of the image to capture a snapshot of the window for a printout. This is done by clicking the right cursor button over the image area. A small window will appear (see Figure 16) and by moving the cursor over this window and releasing the button the cursor location becomes frozen. Any cursor movement is not registered and the profiles plot the data over the point where the cursor was frozen. To un-freeze the cursor location bring the cursor over the image area, right click the mouse button and select the <Un-Freeze> option. The mouse movements will be registered and the profiles will refresh accordingly.

Figure 16: Freezing the cursor location

3.2.1.6. The Scale factor

The scale factor of the displayed image can be changed using the <X-Scale> and <Y-Scale> drop lists. The image's two scales can be changed independently. The maximum scale factor that can be utilized is hardware dependent and the program will list in these drop lists the maximum scale factor available.

3.2.1.7. The Color Tables

The image can be displayed in tones of gray or in color (see example in Figure 17). The user can select one of the predefined color tables listed in Figure 18.

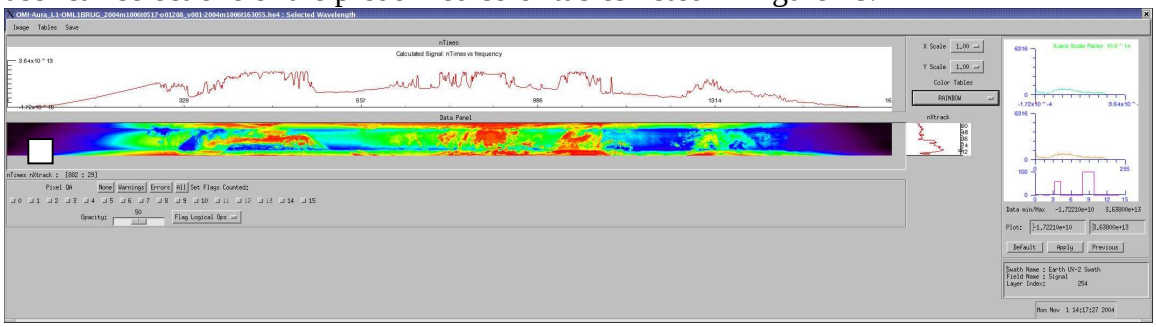


Figure 17: The image displayed with the <Rainbow> color table

Figure 18: The list of available Color Tables

3.2.1.8. Displaying Pixel Quality Flags

The OMI Level 1b data sets contain a wealth of information pertaining to assessments of the data quality. Information on the individual pixel quality is stored in the file as PixelQA flags, information about the quality of the measurement is stored as measurement quality flags, and finally the geolocation quality assessment is stored as geolocation QA flags.

In order to visualize the quality assessment information on the individual pixels, the user can select from the available Pixel QA buttons. By selecting (de-selecting) a button the appearance of the button changes from elevated (sunken) to sunken (elevated). Multiple buttons can be selected simultaneously for display. The transparency of the Pixel QA layer can be varied by the user from 0% (transparent) to 100% (opaque). In the example shown in Figure 19 the opacity was set to 80%.

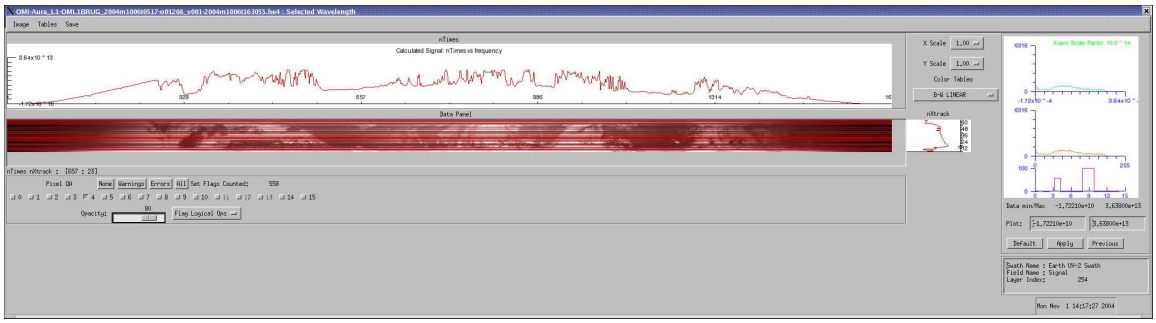


Figure 19: The pixel quality assessment flags visualized (image: gray shades, pixel quality flags: red shades)

As the cursor is moved over the Pixel QA buttons texts appears that identifies the pixel QA flag each of the buttons is selecting. For the convenience of the user, group-buttons are also provided that will select a) all warning flags, b) all error flags, c) reset the flag buttons, and d) set them all.

3.2.1.9. The Histogram Plots and Data Range Interface

The section shown in Figure 20 displays the three plots, text boxes and three control buttons. The first is a plot (drawn in green) of the data distribution. To cover a wide range of possible data values the limits of the horizontal axis are automatically calculated and the <X-scale factor> indicates the scaling factor used. As the data can range from negative to positive values a red line indicates the position of *x=0*. The vertical axis represents the number of occurances for each digital value in the data set. The maximum value for the data set is shown in the top left of the plot, adjacent to the vertical axis.

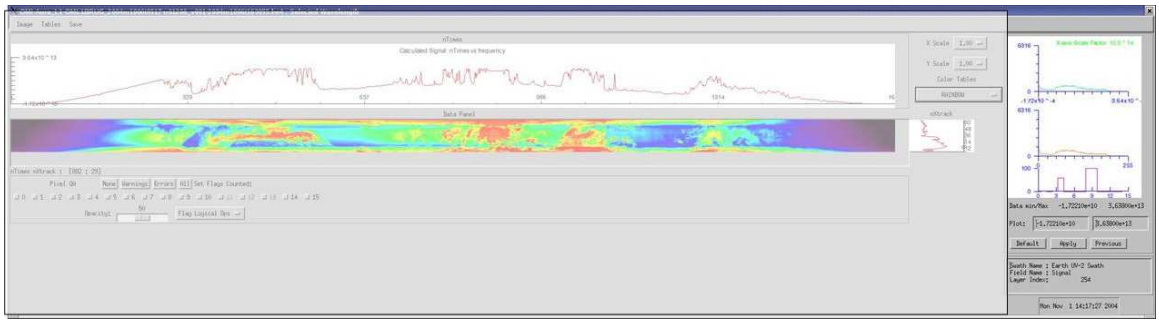


Figure 20: The histogram plot section of the full resolution window

The second histogram depicts the actual data set distribution that are used to display the image on the image panel. In Figure 20 the two histograms are identical. Directly underneath the histogram plots the user can find the minimum and maximum value of the data set. The two text boxes, labeled as <Plot> allow the user to specify the minimum and maximum values (thresholds) to be used to display the image. Once the user selects these two values, and clicks on the <Apply> button the program will use these thresholds and mask out all data that do are not contained within the range specified. This function is useful if for example the user wants to mask out the fill values, or mask out all negative

values. Once the thresholds are set the second histogram plot is refreshed and will display the distribution of the thresholded data set. In this case a new label will appear on the top right side of the histogram indicating the <X-scale factor> used.

The third plot shows the distribution of the Pixel QA flags set in the data set depicted in the image panel. The horizontal axis is split in 16 distinct levels ranging from 0 to 15 for the 16 different Pixel QA flags. The vertical axis is automatically scaled in order for the maximum number of pixel QA flags set to fill the plot area.

The three buttons <Default>, <Apply>, <Previous> set the thresholds to the data minimum and maximum, the user selected minimum and maximum, or the previously selected minimum and maximum values correspondingly.

The text box underneath the buttons captures information on the Swath, field of the image. This provides with the required information identify the image and allows a user to regenerate a printout based on the information shown. Finally, the date/time label at the button helps the user identify when the printout was generated.

4. Appendices

4.1. List of Acronyms

ATBD	Algorithm Theoretical Basis Documents
IDL	Interactive Data Language
OMI	Ozone Monitoring Instrument
OMIDAPS	OMI Data Analysis Processing System
OSIPS	OMI Science Investigator-led Processing System
PGE	Product Generation Executables
RAM	Random Access Memory
RSI	Research Systems Incorporated
QA	Quality Assessment
QADB	Quality Assessment Database
QAS	Quality Assessment System
QAT	Quality Assessment Team
STM(s)	Science Team Member(s)

4.2. Troubleshooting

4.3. Reporting a Bug

4.3.1. Checking the database of known bugs

When a bug is identified the user can check the data base of known bugs and if the bug found is not listed, the user can file a new bug. The process of checking the current bugs reported requires the user to login to the web site: https://omiwww.gsfc.nasa.gov and then select the option: <*Bugzilla*> and then <*Query existing bug reports*>. A new page will be loaded that looks like the page shown in Figure 21, in page 21. From the <*Products*> scroll list select <*Tools*> and from the <*Components*> select <*QA Viewer*>, and then specify the version number. By default bugzilla will report any new, assigned and reopened bugs (highlighted in the example page under the <*Status*> scroll list). By

selecting <*Search*> the system will provide the user with a list of "hits", and a brief description. If more information is required the user can select a bug and read more detailed information.

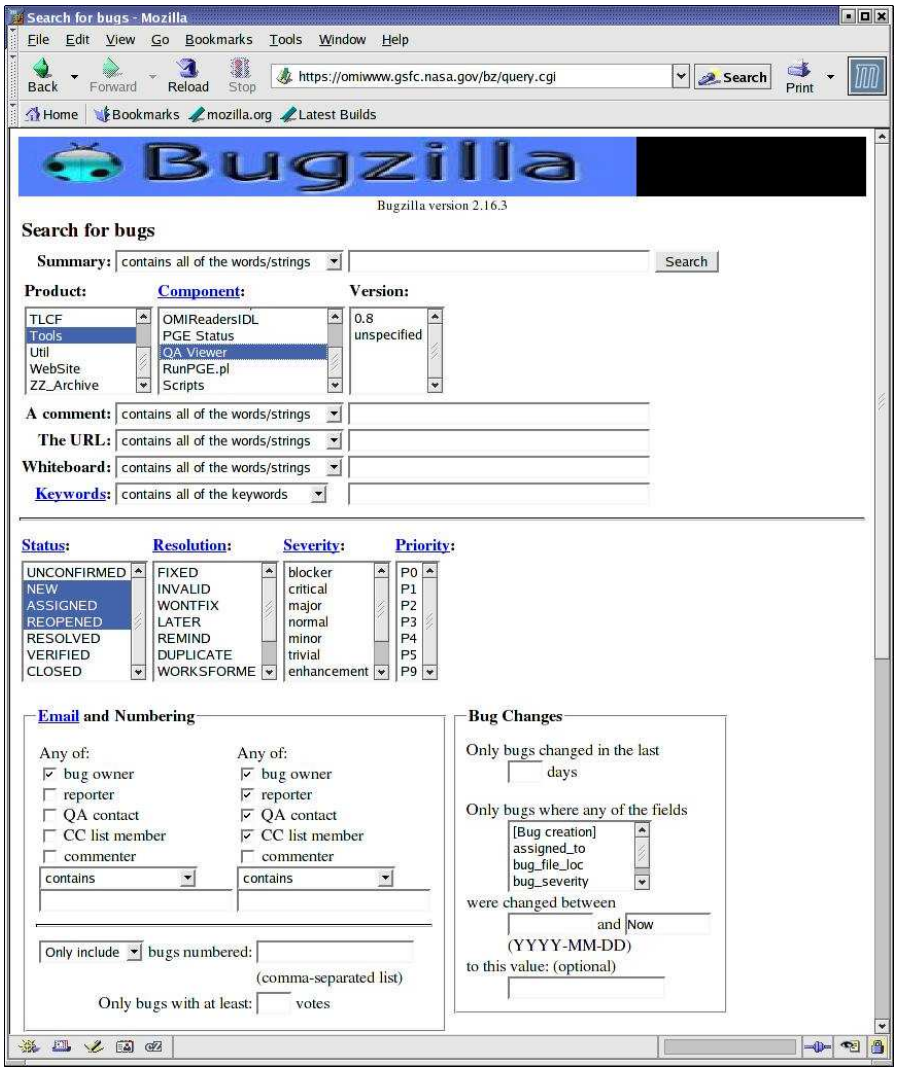


Figure 21: example of the Bugzilla query database page

4.3.2. Filling a new bug in the database

https://omiwww.gsfc.nasa.gov ->
<Bugzilla> ->
<Enter New Bug> -> <Tools> -> select <QA Viewer> from the scroll list

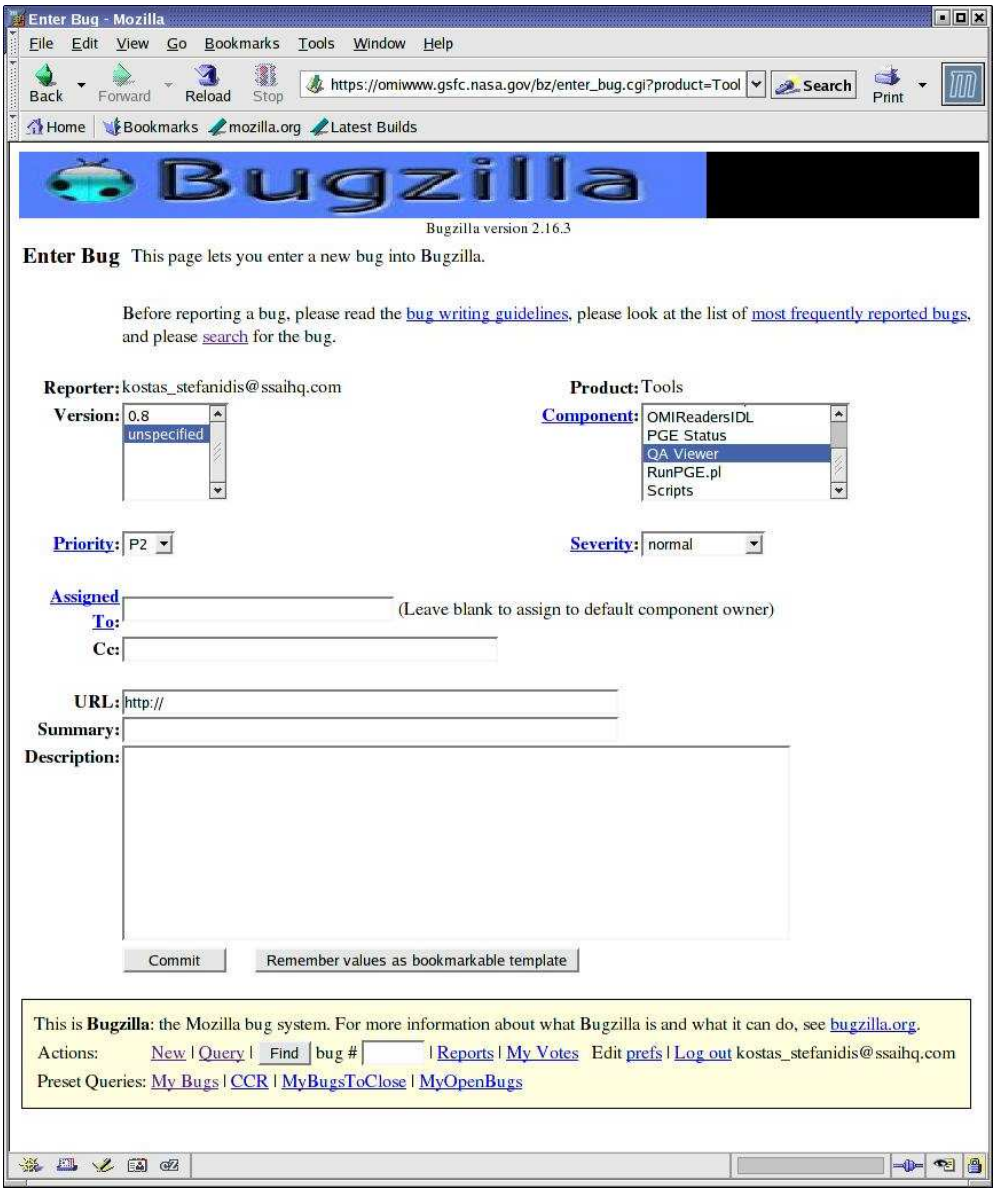


Figure 22: example of the Bugzilla filling new bug page

4.4. Examples of Level 1b Data Product QA Information

NrDarkMeasurements
NrEarthMeasurements
NrLEDMeasurements
NrSolarMeasurements
NrWLSMeasurements
PathNr
QAStatMissingData
QAStatPChargeTransferEfficiencyxpSmear
QAStatPctGeolocationErrorUV1
QAStatPctGeolocationErrorUV2
QAStatPctGeolocationErrorVIS
QAStatPctMeanNonlin
QAStatPctMeasDark
QAStatPctMeasErrorUV
QAStatPctMeasErrorUV1
QAStatPctMeasErrorUV2
QAStatPctMeasErrorVIS
QAStatPctMeasMissing
QAStatPctMeasOffset
QAStatPctMeasSatADC
QAStatPctMeasStray
QAStatPctmeasTransient
QAStatPctMeasWarningUV
QAStatPctMeasWarningUV1
QAStatPctMeasWarningUV2
QAStatPctMeasWarningVIS
QAStatPctPixBadUV
QAStatPctPixBadUV1
QAStatPctPixBadUV2
QAStatPctPixBadVIS
QAStatPctPixProcessingErrorUV
QAStatPctPixProcessingErrorUV1
QAStatPctPixProcessingErrorUV2
QAStatPctPixProcessingErrorVIS
QAStatPctPixWarningUV
QAStatPctPixWarningUV1
QAStatPctPixWarningUV2

QAStatPctPixWarningVIS
SolarAzimuthAngleMax
SolarAzimuthAngleMin
SolarEclipse
SolarElevationAngleMax
SolarElevationAngleMin
SouthAtlanticAnomalyCrossing
SpacecraftManeuverFlag